

Note: (a) All questions are compulsory.

(b) Marks are indicated against each question in square brackets.

(c) The candidate is allowed to make suitable numeric assumptions wherever required for solving problems

- Q1. Suppose a genetic algorithm uses chromosomes of the form $x = abcdefgh$ with a fixed length of eight genes. Each gene can be any digit between 0 and 9. Let the fitness of individual x be calculated as: $f(x) = (a + b) - (c + d) + (e + f) - (g + h)$ and let the initial population consist of four individuals with the following chromosomes:

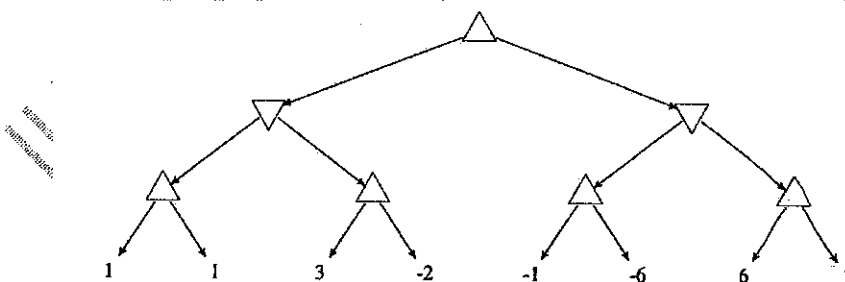
$$x_1 = 65413532$$

$$x_2 = 87126601$$

$$x_3 = 23921285$$

$$x_4 = 41852094$$

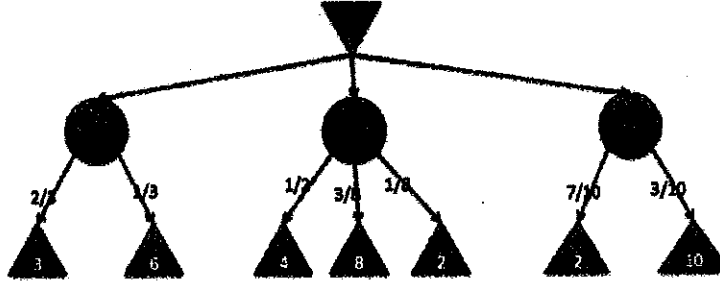
- (a) Evaluate the fitness of each individual, showing all your workings, and arrange them in order with the fittest first and the least fit last. [2+2]
CO1
- (b) What is the significance of crossover operator in the genetic algorithms? Perform the crossover operation on the fittest two individuals using one-point crossover at the middle point.
- Q2. (a) Describe simulated annealing search algorithm. [2+2]
CO1
- (b) In particular, precise how the algorithm behaves at very high temperatures and at very low temperatures.
- Q3. Two players, MAX and MIN, are playing a game. The game tree is shown below. [2+2+2]
CO1
- Upward-pointing triangles denote decisions by MAX; downward-pointing triangles denote decisions by MIN. Numbers on the terminal nodes show the final score: MAX seeks to maximize the final score, MIN seeks to minimize the final score.



- (a) Write the minimax value of each non-terminal node (each upward-pointing or downward-pointing triangle) next to it.
- (b) Suppose that the minimax values of the nodes at each level are computed in order, from left to right. Encircle the edges that would be pruned (eliminated from consideration) using alpha-beta pruning.

- (c) In this game, alpha-beta pruning did not change the minimax value of the start node. Is there any deterministic two-player game tree in which alpha-beta pruning changes the minimax value of the start node? Why or why not?

- Q4. (a) What are the main challenges of adversarial search as contrasted with single-agent search? [2+4]
CO1
(b) Consider the following expectiminimax tree:



Circle nodes are chance nodes, the top node is a min node, and the bottom nodes are max nodes.

- (a) For each circle, calculate the node values, as per expectiminimax definition.
(b) Which action should the min player take?
- Q5. Differentiate between forward and backward chaining mode of the Inference Engine? [5]
CO3